

Approved by:

_____/_____/_____
Process Engineer_____/_____/_____
Equipment Engineer

1 SCOPE

The purpose of this document is to detail the use of the CVC 601 Sputtering System. All users are expected to have read and understood this document. It is not a substitute for in-person training on the system and is not sufficient to qualify a user on the system. Failure to follow guidelines in this document may result in loss of privileges.

2 REFERENCE DOCUMENTS

- 2.1 Safety Data Sheets for the metals that are being sputtered.
- 2.2 TI-99 Programmable Controller
- 2.3 SLO-SYN Preset Indexer Type SP155A Manual
- 2.4 ENI RPG-50 Pulsed DC Plasma Generator Manual
- 2.5 MKS Type 247D 4 Channel Readout Manual
- 2.6 CTI Cryopump/compressor

3 DEFINITIONS

- 3.1 Cryopump – high vacuum pump used for ultimate process chamber vacuum
- 3.2 Platen – large metal disk that holds wafers inside the process chamber
- 3.3 Roughing pump – primary vacuum pump used for initial chamber evacuation
- 3.4 Target – source material to be sputtered (4” or 8” diameter)

4 TOOLS AND MATERIALS

4.1 General Description - The CVC 601 is a 4 target DC sputtering system primarily used for metal deposition. There are 3 8-inch targets and 1 4-inch target. The currently installed targets are specified on the front of the control rack.

4.2 Fixtures

4.2.1 The Wafer Platens are stored on a cart on the right hand side of the CVC 601.

4.2.2 The dummy wafers, wafer holders and other miscellaneous supplies are located in the drawer on the right of the control rack or on top of the tool.

4.3 Targets

4.3.1 Target changes should be coordinated with a staff member.



Figure 1: CVC 601 Control Racks and Chamber

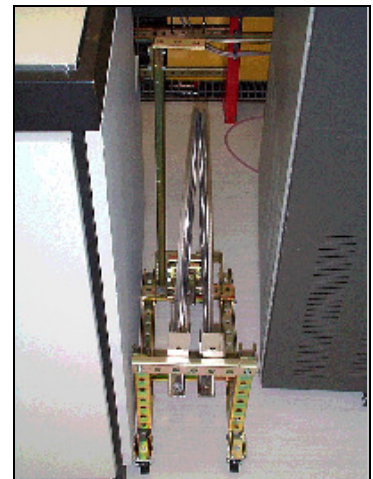


Figure 2: Platen Cart to the right of the chamber



Figure 3: Center Control Rack

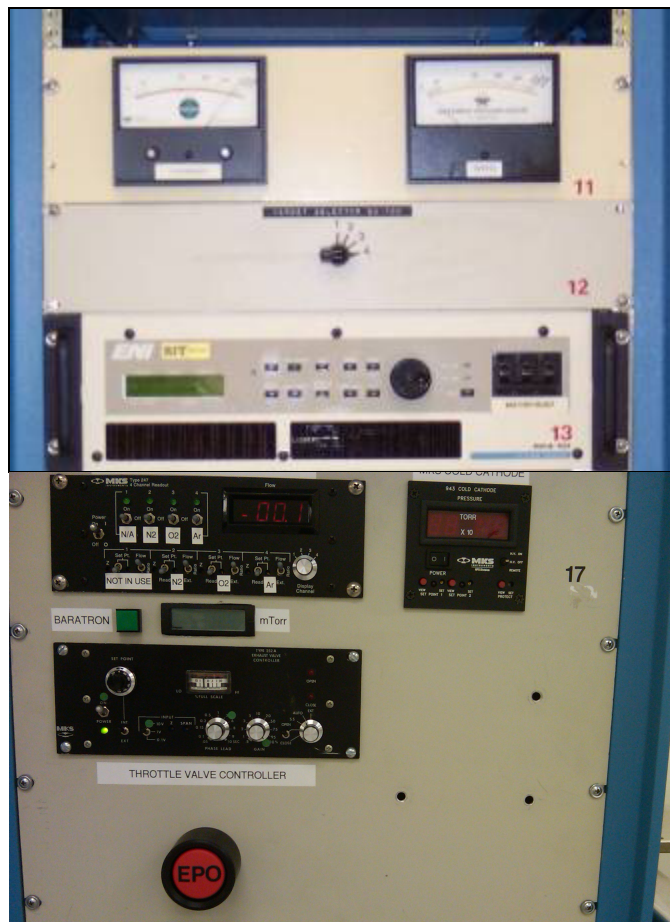


Figure 4: Right Control Rack



Figure 5: Left Control Rack

5 SAFETY PRECAUTION

5.1 Safety Hazards

- 5.1.1 **Voltage** – The CVC 601 employs AC, DC and RF energies that are dangerous and may be fatal to personnel. Do not attempt to defeat protective interlock systems.
- 5.1.2 **Compressed Gases** – The CVC 601 is operated with compressed gases. Do not attempt to defeat protective interlock systems.
- 5.1.3 **Mechanical Hazards** – Drive assemblies have sufficient power to cause injury. Keep hands, fingers, clothing and tools clear of moving parts. The chamber lid can create a pinch hazard.

5.2 Hazards to the Tool

- 5.2.1 **Vacuum** - Failure to ensure CVC 601 has switched to high vacuum.
- 5.2.2 **Excessive Power** - Eight-inch bonded targets may use powers up to 2000W. Four inch targets may use powers up to 500 W, except as noted on the tool (germanium, etc.).
- 5.2.3 **Target Placement** - DO NOT place a target on top of another target. This will fuse the targets together and to the top clamp ring.
- 5.2.4 **Contactor Box** – The contactor box should remain on at all times. If this is turned off, the vacuum may have to be regenerated.

6 INSTRUCTIONS

6.1 Service Chase Set Up

- 6.1.1 In **Service Chase 2715**, turn on the **Vent Nitrogen** for the CVC 601. It is located on the Nitrogen Manifold 2715 above the gas cylinders in the service.
- 6.1.2 The **Contactor Box** is normally left on. *Do not turn this off.*
- 6.1.3 Turn on CVC-601 **Mechanical Pump Power Switch** by pressing the [START] button (**Panel #18**).
- 6.1.4 Turn on **Water Pump Switch** (**Panel #16**).
- 6.1.5 Verify that the outlet pressure for the argon is about 15 psi. *Do not adjust.*
- 6.1.6 Verify that the outlet pressure for the oxygen is about 15 psi, if the oxygen is needed. *Do not adjust.*

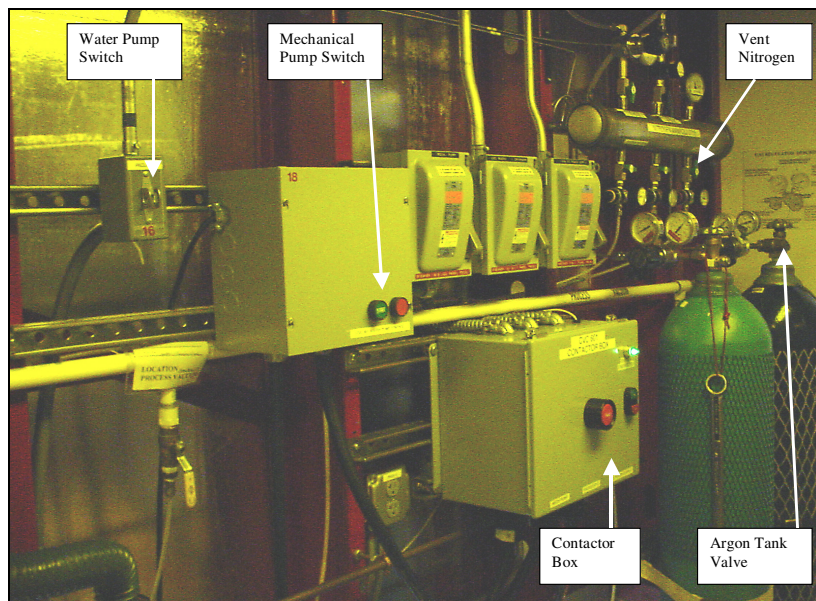


Figure 6: CVC 601 Service Chase

6.2 Vent the Chamber

- 6.2.1 Make sure the tool is swiped in on the **Card Swipe System**.
- 6.2.2 The **Vacuum Control Mode** switch should be in the **AUTO** position with the red indicator illuminated (**Panel #4**).
- 6.2.3 On the MKS Type 247 4 Channel control, the **Flow Control Switches** and the **Power** switch should be in the **OFF** position as shown in Figure 11 (**Panel #17**).
- 6.2.4 The cryo pump pressure is displayed on the right hand gauge on the Vacuum Gauge Control (**Panel #11**). The cryo pump pressure must be below 10 mtorr. If it is not, seek technical assistance before continuing.
- 6.2.5 Turn off the MKS Cold Cathode Gauge. (**Panel #17**)
- 6.2.6 Depress the red **STOP** push-button switch on the Vacuum Valve Control (**Panel #1**) Located on the left hand rack. This isolates the chamber from the cryo pump.
- 6.2.7 Wait 1 minute after pressing the Stop button to allow operation to finish. Depress the yellow **VENT** push-button switch on the Vacuum Valve Control (**Panel #1**). Wait a few minutes for the chamber to vent. The chamber lid will rise about a 1/16" when venting is complete.

6.3 Load the Chamber

- 6.3.1 Change the platen if it is not the correct size; otherwise keep the lid in the lowered position while loading wafers.

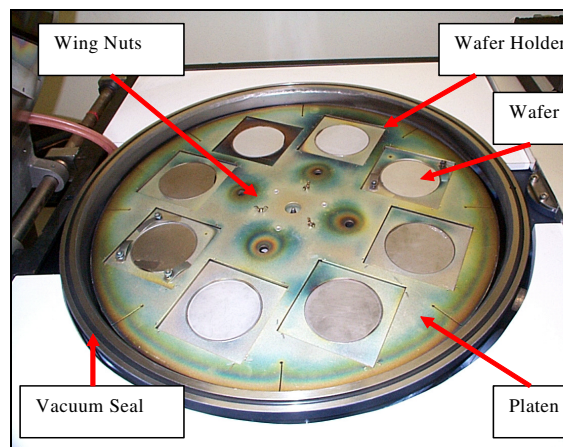


Figure 7: Inside the Vacuum Chamber with the Platen

- 6.3.2 Remove all of the wafers, dummies and wafer holders from the platen, shown in **Figure 7**.
- 6.3.3 Grab hold of the platen and carefully lift it straight up and out of the chamber. Don't allow the platen to hit the sides of the vacuum chamber or the vacuum seal ledge. Set the platen on the center bench. If the chamber has flakes, vacuum out the flakes. Inspect the target for excessive wear.
- 6.3.4 Unscrew the wing nuts from the center of the platen and remove it from the hub. Place the platen in the rack on the right side of the machine. Set the new platen on the hub and screw the wing nuts back on.



Figure 8: Platen Hub

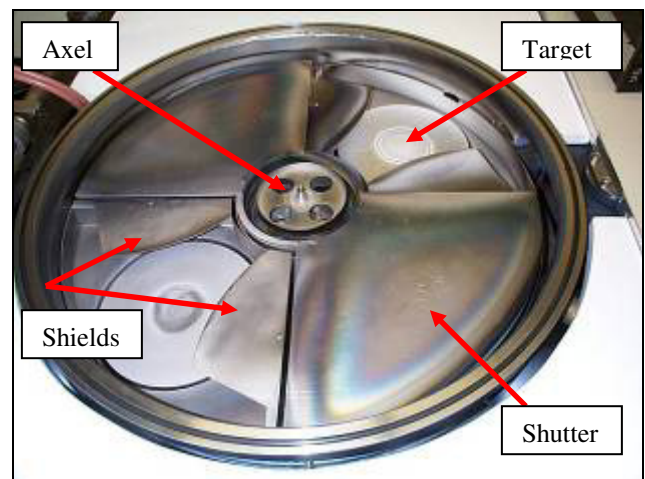


Figure 9: Inside the Vacuum Chamber Without the Platen

- 6.3.5 Carefully set the platen back down into the vacuum chamber on the center axle. Don't allow the platen to hit the sides of the vacuum chamber or the vacuum seal ledge. Load your substrates using the vacuum wand located on the side of the chamber.
- 6.3.6 Place your substrates face down on the holder since materials are sputtered from below. If using the 4" target, make sure that you are using a platen that centers the wafers over the target to ensure the best uniformity.
- 6.3.7 Verify that the platen and the shutter rotate freely and do not bind on the shields. If the shields are bent or have excessive buildup, check with a staff member.

- 6.3.8 Fill all the blank spaces on the platen with dummy wafers located on top of the right side of the chamber. Make sure the dummy wafers are not flaking metal from a previous sputter. Flakes will cause arcing in the chamber. A thickness measurement can later be taken on the Tencor P2 Profilometer if you attach a clean glass slide to one of the dummy wafers with Kapton tape found in the drawer on the right control rack.

6.4 Pump down the Chamber

- 6.4.1 Wipe the lid o-ring with some alcohol and a Kim Wipe to remove any particles.
- 6.4.2 The **Throttle Valve Controller** on **Panel #17** should be set to **OPEN**. Make sure the indicator light is lit.
- 6.4.3 Press the green **START** push-button switch on the Vacuum Valve Control (**Panel #1**). The indicator labeled **601 ROUGH** will illuminate. Firmly hold the chamber lid down and wait for the vacuum pump to pull the lid down.
- 6.4.4 Monitor the chamber pressure on the left meter [**Chamber**] (**Panel #11**). The chamber pressure will begin to decrease after a few minutes. If the chamber pressure has not decreased to **100 mtorr** after **10 minutes** of pumping get assistance from the equipment engineer.
- 6.4.5 When the chamber pressure reaches **40 mtorr** the high vacuum valve will open and the 601HV light on the Vacuum Valve Control (**Panel #1**) will illuminate indicating that the cryo pump is pumping on the chamber.
- 6.4.6 Turn on the Cold Cathode Vacuum Gauge (**Panel #17**). Set the high voltage switch to **H.V. ON**. Allow unit to pump down to **<10E-4**. To improve pump down speed, do the optional radiant heating as in **Step 6.5**.
- 6.4.7 When finished pumping down, record the base pressure, turn off the high voltage switch on the Cold Cathode Controller and then turn off the power to the **Cold Cathode Controller** (**Panel #17**).

6.5 Optional Radiant Heater Instructions

- 6.5.1 Verify that the **Water Pump Switch** (**#16**) located on the wall in the service chase above the CVC-601 Roughing Pump is ON. Verify that none of the red lights on the Coolant Flow Control (**Panel #3**) are illuminated. If any of these lights are still illuminated, seek assistance from the Equipment Engineer.

- 6.5.2 Move the **POWER** toggle switch on the Superior Electric Indexer (Panel #10) to the **ON** position.
- 6.5.3 Turn on the green **ROTOSTRATE** (Panel #4) toggle switch so that the light above it illuminates. The substrate holder will now rotate.
- 6.5.4 Move the **HEATER** switch (Panel #8) to the **ON** position.
- 6.5.6 Move the **WORK HEATER CONTROL** breaker (Panel #9) to the **ON** position.
- 6.5.7 Adjust the temperature set point knob on the **WORK HEATER CONTROL** (Panel #9) to 300° C.
- 6.5.8 Set the **PROCESS TIMER** (Panel #5) to 20 minutes.
- 6.5.9 Move the **TIMED** switch on the Master Control (Panel #5) to the **START** position.
- 6.5.10 After the time set by the **PROCESS TIMER** has elapsed, the **TIMED** switch on the Master Control (Panel #5) will turn off.
- 6.5.11 Move the **HEATER** switch (Panel #8) to the **OFF** position.
- 6.5.12 Move the **WORK HEATER CONTROL** breaker (Panel #9) to the **OFF** position.

6.6 DC Sputtering

- 6.6.1 Set the **Selector Switch** to the desired target (Panel #12).
- 6.6.2 Turn **OFF** MKS Cold Cathode Gauge (Panel #17).
- 6.6.3 Turn **ON** the CVC-601 Water Pump (#16) switch located on the wall in the service chase above the CVC-601 Roughing Pump. If you have done an overnight pump down, the N2, Mechanical pump and water pump typically get turned off.
- 6.6.4 Verify that none of the red lights on the Coolant Flow Control (Panel #3) are illuminated. If any of these lights are illuminated, seek assistance from the Equipment Engineer.
- 6.6.5 Move the **POWER** toggle switch on the Superior Electric Indexer (Panel #10) to the **ON** position.
- 6.6.6 Turn the green **ROTOSTRATE** (Panel #4) toggle switch so that the green light above it illuminates. The substrate holder will now rotate.

- 6.6.7 Move the **SHUTTER** toggle switch (Panel #15) to the position that will *cover* the target that is to be sputtered.
- 6.6.8 Turn **ON** the Baratron gauge by pressing the green button (Panel#17).



Figure 10: Panel 15 on Front of Process Chamber

- 6.6.9 Lift the toggle switches for the appropriate gases needed (Panel #15).
- 6.6.10 Turn **ON** the **POWER** switch on the MKS Type 247 4 Channel control by pulling out on the switch and then pushing up. The gas switches should be in the **OFF** position (Panel #17) as shown in **Figure 11**.

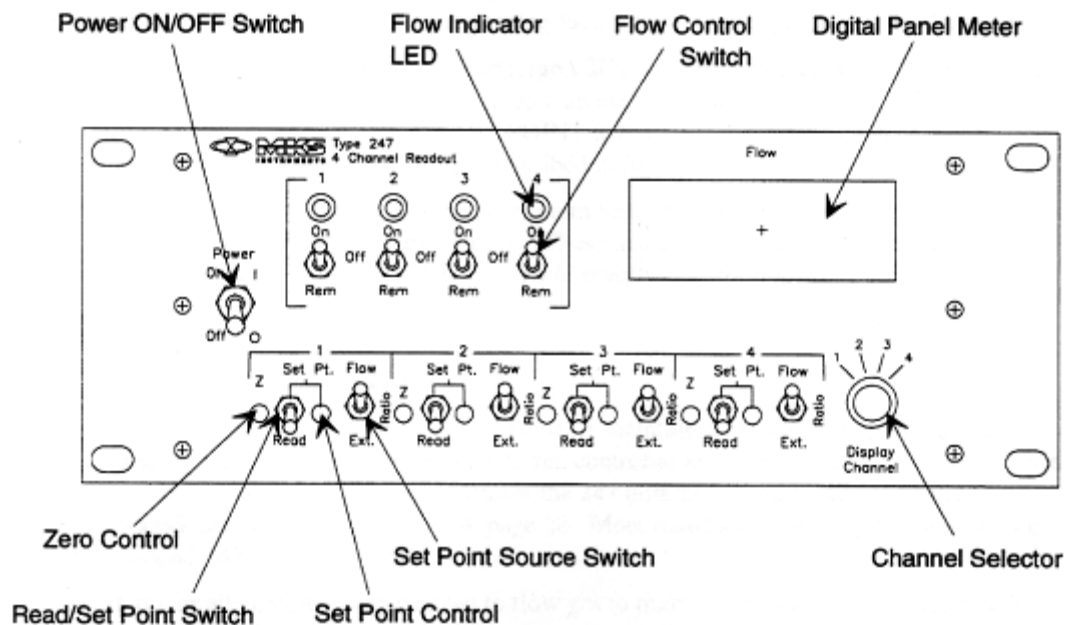


Figure 11: MKS Type 247 4 Channel MFC Controller

- 6.6.11 Use the **Channel Selector** knob to select the appropriate gas channel to be displayed. (Panel #17)
- 6.6.12 Press up on the **Read / Set Point** switch to view the flow set point for that channel (Panel #17).
- 6.6.13 While holding the **Read / Set Point Switch** up, use the screwdriver to turn the **Set Point Control Screw** for that channel until the desired set point is obtained (Panel #17). Screwdriver will be in drawer or attached to the front of the tool.
- 6.6.14 Switch the **Flow Control Switch** to the **ON** position for the gas used (Panel #17). Make sure the "Flow" switch is also in the up position.
- 6.6.15 Adjust the **Set Point Control Screw** for that channel until the desired gas flow is obtained. (Panel #17).
- 6.6.16 Check the Baratron Gauge (Panel #17) for the chamber pressure.
- 6.6.17 Switch the **Throttle Valve Controller** to **Auto** on Panel #17. The chamber pressure may be set by varying the **set point** dial on the **Throttle Valve Controller**.

- 6.6.18 Pre-sputtering is always performed with the shutter closed to prevent deposition on your substrates. The purpose of pre-sputtering is to remove unwanted oxides or contamination from the target. The sputter rate data in the log sheet may aid in the choice of sputter power and deposition time. Verify that the **SHUTTER** switch (Panel #15) is in a position covering the target you want to use.
- 6.6.19 Do not sputter above 2000 Watts for 8" targets. For targets in the 4" sputter head, do not sputter above 500 Watts. **Do not place a target on top of another target. This will fuse the targets together and to the top clamp ring. Do not go above 100W for GERMANIUM.**
- 6.6.20 Turn **ON** the **MAIN POWER** breaker on the DC Power Supply (Panel #13). If display reads "INTLK OPEN", then press [**FAULT RESET**] button. If display still reads "INTLK OPEN", then seek assistance from the Equipment Engineer.
- 6.6.21 Make sure that power supply is in the DC mode. Press **Menu** until **RPG Menu** is displayed. Press **Item** until **Pulse Mode** is displayed. If **Pulse Mode** is **On**, turn it **Off** with the rotary knob. Press **Exit** when finished. Note that certain recipes may require the Pulse Mode to be on.
- 6.6.22 The display on line 2 of DC Power Supply (Panel #13) should end with "s". If not press [**RUN MODE**] button until "s" is displayed.
- 6.6.23 On the DC Power Supply (Panel #13), turn the rotary knob to the desired pre-sputter time in seconds.
- 6.6.24 Press the [**RUN MODE**] button until the second line of the display ends with "**Ramp Run**" in straight DC power mode or "ns" in pulsed DC power mode. Turn the rotary knob to the pre-sputter power value that matches your desired sputter power (Panel #13).
- 6.6.25 Press the [**RUN MODE**] button several times until line 2 on the DC Power Supply ends in "s" again (Panel #13).

- 6.6.26 Press the **ON/OFF** button to distribute power to the target. (Panel #13) When pre-sputter time has elapsed, the power will no longer be distributed to the target. If you see a lot of arcing, you could pre-sputter longer. A newly installed target might need more pre-sputtering. Seek staff assistance if needed.
- 6.6.27 At the end of the allotted pre-sputter time move the **SHUTTER** switch (Panel #15) to the position that uncovers the target to be sputtered.
- 6.6.28 Ensure the display is still in seconds. If not press the [**RUN MODE**] button several times to display seconds again.
- 6.6.29 On the DC Power Supply (Panel #13), turn the rotary knob to desired sputter time in seconds.
- 6.6.30 Press the **ON/OFF** button to distribute power to the target. When the sputter time has elapsed, the power will no longer be distributed to the target.
- 6.6.31 Turn **OFF** the MAIN POWER breaker on the DC Power Supply (Panel #13).
- 6.6.32 Switch the **Flow Control Switch** to the **OFF** position for the gas used on the MKS Type 247 4 Channel control (Panel #17).
- 6.6.33 Turn **OFF** the **POWER** switch on the MKS Type 247 4 Channel control (panel #17).
- 6.6.34 Turn **OFF** the GAS INLET VALVES (Panel #15).
- 6.6.35 Move the **Throttle Valve Controller** set point to **Zero** and set the switch to **Open** (Panel #17). The Open indicator light will come on. **Do not turn off the Throttle Valve Controller.**
- 6.6.36 Turn off the Baratron (Panel #17).
- 6.6.37 Move the green **ROTOSTRATE** switch (Panel #4) to the **OFF** position.
- 6.6.38 Move the POWER toggle switch on the Superior Electric Indexer (Panel #10) to **OFF**.

6.7 Substrate Removal

- 6.7.1 Depress the red **STOP** button switch on the Vacuum Valve Control (Panel #1).
- 6.7.2 Wait a minute and then press the yellow **VENT** button switch on the Vacuum Valve Control (Panel #1). The system is finished venting when a gap can be seen between the door and the chamber.

- 6.7.3 Raise the chamber lid and remove your substrates with the vacuum wand, minimizing the time the lid is open.

6.8 Machine Shut Down Conditions

- 6.8.1 Close the chamber lid.
- 6.8.2 Depress the green **START** push-button switch on the Vacuum Valve Control (Panel #1). Hold the chamber lid down until the vacuum pulls the lid down tightly. **DO NOT LEAVE MACHINE UNTIL UNIT CROSSES OVER INTO HI VAC.**
- 6.8.3 Wait for the **HV601** light (Panel #1) to illuminate indicating that the system is in high vacuum and then turn on the MKS Cold Cathode Gauge.
- 6.8.4 Check that **MAIN POWER** breaker on the DC Power Supply is **OFF** (Panel #13).
- 6.8.5 Turn off the Baratron gauge by pressing the green button (Panel#17).
- 6.8.6 Move the **ROTOSTRATE** toggle switch (Panel #4) to the **OFF** position so that the green light above it is extinguished.
- 6.8.7 The Throttle Valve Controller set point should be zero and it should be open. The Open indicator light will be on. **Do not turn off the Throttle Valve Controller.**
- 6.8.8 Move the **HEATER** switch (Panel #8) to the **OFF** position.
- 6.8.9 Move the **WORK HEATER CONTROL** breaker (Panel #9) to the **OFF** position.
- 6.8.10 Turn off the Superior Electric Indexer (Panel #10).

6.9 Service Chase Shut Down



- 6.9.1 **TURN OFF THE CVC-601 ROUGH PUMP** by pressing the **red OFF** button. (Panel #18 - CVC-601 Mechanical Pump Power Switch).
- 6.9.2 If you used the radiant heater, wait at 10 minutes before turning **OFF** the WATER PUMP (#16), otherwise turn **OFF** the WATER PUMP.
- 6.9.3 Turn **OFF** the VENT NITROGEN for CVC-601.

6.10 Errors during Run

6.10.1 System is not venting:

6.10.1.1 Make sure the card swipe for the CVC 601 is enabled.

6.10.1.2 Make sure the nitrogen vent valve in the chase is **OPEN**.

6.10.2 System not pumping down:

6.10.2.1 Make sure the roughing pump is **ON**.

6.10.2.2 Make sure the o-ring and sealing surface is clean.

6.10.3 MKS Cold Cathode Gauge (Panel#17) displays 1E-10 torr:

6.10.3.1 Allow the gauge to warm up with the **H.V. ON**. It may require up to half an hour.

6.10.4 No gas flow:

6.10.4.1 Make sure the valve on the gas tank is **OPEN** and the correct pressure is displayed.

6.10.4.2 Make sure the toggle switch for the gas is **ON**. (Panel #15)

6.10.4.3 Make sure the display select knob is on the correct channel.

6.10.5 Lower pressure than expected at same gas flow:

6.10.5.1 Make sure the **Throttle Valve Controller** is in the correct position.

6.10.6 Platen is not rotating:

6.10.6.1 Make sure the Superior Electric Indexer (Panel #10) is **ON**.

6.10.6.2 Make sure the green **ROTOSTRATE** (Panel #4) is **ON**.

6.10.6.3 Make sure the settings on the Superior Electric Indexer (Panel #10) are correct. The Count Insertion dials should read: Ext, 0, 0, 0, 2, 0, going from left to right. The Select switch should be in the Index position.

7 APPROPRIATE USES OF THE TOOL

- 7.1 The total sputtered film thickness should not be more than 1 micron. The target might be sputtered through to the copper backing plate.

REVISION RECORD

Summary of Changes	Originator	Rev/Date
Original Issue	Michael Meagher	A-01/22/03
Added changes and revised format	Scott Blondell	B-09/24/03
Service chase setup with contactor box	Sean O'Brien	C-03/29/04
Added information about manual throttle control 6.1.2.2, 6.2.5.9, 6.2.5.39, 6.2.7.7	Sean O'Brien	D-06/22/05
Added 6.2.2.6, modified 6.2.5 to give information on turning off pulse mode, clarified some sections and modified formats.	Sean O'Brien	E-12/16/05
Removed section 6.2.5.8 to close throttle	Sean O'Brien	F-07/23/2007
Added 6.2.1.2, 6.2.6.9, removed references to Pirani gauge, rearranged 6.2.6 and 6.2.7	Sean O'Brien	G-02/10/2009
Reworked to improve process flow, made some clarifications	Sean O'Brien	H-08/19/2009
Changed 6.4.2, 6.6.17, 6.6.35, 6.8.7 to reflect new throttle valve controller	Sean O'Brien	I-02/23/2010
Added more details, 1 min. wait before venting	Meller/O'Brien	J-06/12/2020